SECTION 9

TRANSMISSION

INDEX

Part B

9B - 8 X 8 SYNCHROMESH GEAR BOX - DUAL CLUTCH

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9B.1 SPECIFICATION:

Model	-	8 Speed synchromesh shuttle gear box.
No.of gears - Forward	-	8
No.of gears - Reverse	-	8
Setting required:		
Main shaft end float	-	0.003 - 0.011 inch (0.080 - 0.30 mm)
Type of adjustment	-	Variable thickness thrust washer.
Synchromesh ring to coulper clearance - installed	-	0.031 inch (0.8 mm).
Synchromesh ring to coupler clearance - removed	-	0.019 inch (0.5 mm).
Epicyclic reduction unit	-	4:1 - Normal duty only.

Special Tools:

MF.218 B	-	PTO bearing housing replacer.
MF.255 B	-	PTO input shaft oil seal replacer.
MF.315 A	-	Needle roller bearing remover / replacer.
MF.414 A	-	Synchromesh centralising pin.
MF.415	-	Synchromesh hub assembly tool.
MF.421	-	Needle roller bearing and seal replacer.
MF.422 A	-	Needle roller bearing and seal remover.
MS.550	-	Drive handle.
MF.177A	-	Input shaft oil seal protector sleeve.
SER3000007	-	Side shift & high/low service tool

Bolt Torques

Steering wheel nut	-	35 lbf.ft. (47 Nm).
Gear lever cover to gearbox top	-	83 lbf.ft. (112 Nm).
Shifter fork locking screws	-	32 lbf.ft. (44 Nm).
Interlock mechanism bolt to gearbox case	-	32 lbf.ft. (44 Nm).
Epicyclic unit to gearbox case	-	32 lbf.ft. (44 Nm).
Input shaft housing to gearbox case	-	43 lbf.ft. (58 Nm).
PTO drive shaft bearing housing to gear box	-	43 lbf.ft. (58 Nm).

9B . 2 GENERAL DESCRIPTION:

The 8 Speed Synchromesh Shuttle Gearbox has eight forward and eight reverse gears; the forward reverse (shuttle) selection being controlled by a lever on the instrument panel adjacent to the steering wheel. It provides full engine braking on over-run and enables the tractor to be towed to start the engine.

Drive arrangements

From the constructional viewpoint the gearbox has three sections. The front section consists of the forward and reverse gears with synchromesh coupler.

The centre section comprises constant mesh gear sets giving four basic forward and reverse speeds with synchromesh engagement on all gears while the rear section consists of an epicyclic gear reduction unit offering an alternative low range output drive ratio. The four basic forward and reverse speeds are doubled by the ability of the epicyclic unit to provide the additional output ratio. This feature, doubles the number of speeds available and gives the gearbox a total of eight forward speeds and eight reverse.

The gearbox mainshaft is located above the layshaft which is of hollow construction to accept the power take-off (PTO) drive shaft which runs within it. Drive from the engine enters the gearbox through the input shaft which is spigot mounted at its front end into the mainshaft. The forward and reverse gears are splined to the input shaft and are in constant mesh with corresponding free-running gears on the front of the layshaft. The front or reverse gears drive through an idler gear to give the reverse motion. Drive through either of these free-running gears occurs when the one selected is engaged with the layshaft by the sliding coupler of the synchromesh mechanism.

The PTO drive enters the gearbox through a hollow shaft revolving on the outside of the gearbox input shaft. A spur gear pinion at the rear of the hollow PTO input shaft is permanently engaged with the gear splined to the PTO drive shaft. The mainshaft carries four free-running gears, all of which are in constant mesh with corresponding fixed gears on the layshaft to give the basic 1st, 2nd, 3rd and 4th ratios.

The 2nd, 3rd and 4th ratio, forward and reverse gear sets are of the straight cut spur type. The 1st ratio gear set has helical teeth which have longer contact areas and are consequently capable of transmitting greater loads than straight cut gears of the same size. They are also quieter running.

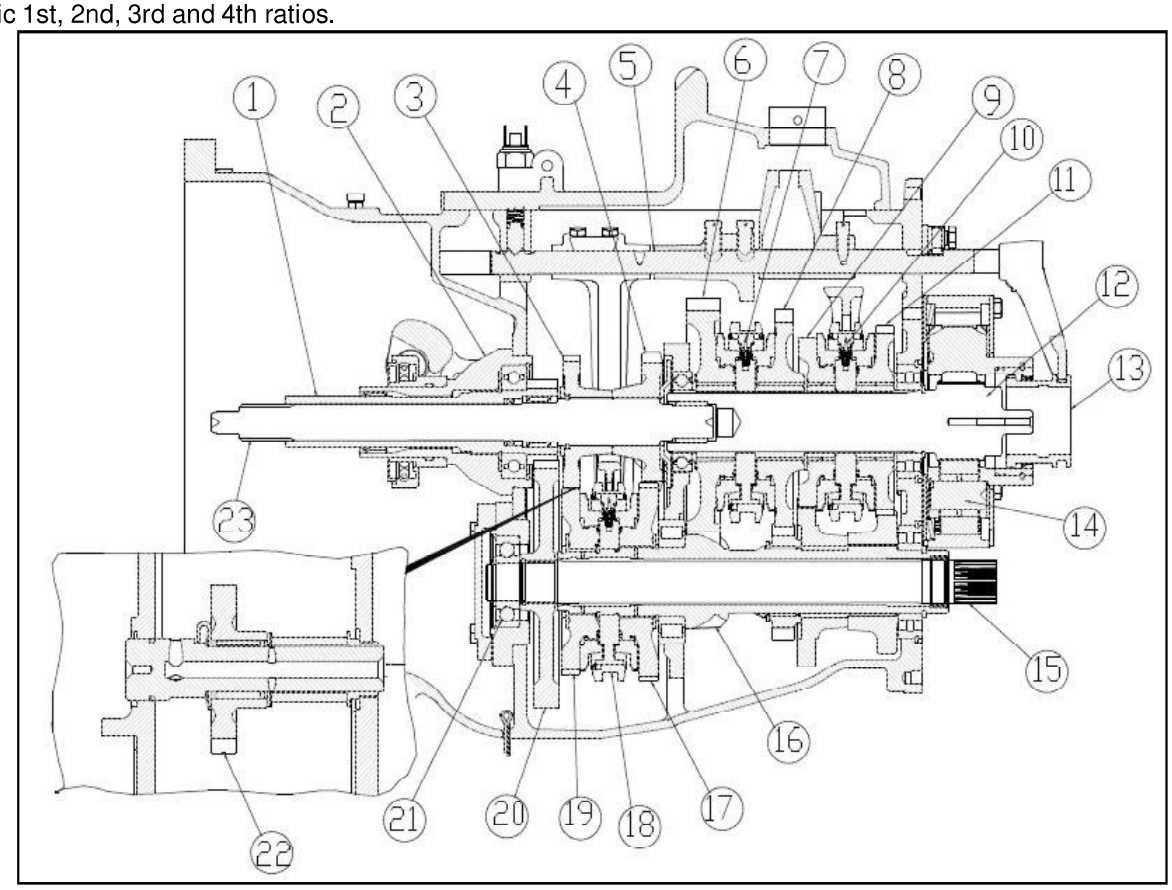


Fig 1

CENTER SHIFT

1. PTO input shaft and gear
2. Input shaft housing
3. Reverse gear constant mesh drive gear
4. Forward gear constant mesh drive gear
5. Selector rails and forks
6. 1st speed driven gear
7. 1st/2nd gear synchronized coupler
8. 2nd speed gear
9. 4th speed driven gear
10. 3rd/4th gear synchronized coupler
11. 3rd speed driven gear
12. Main shaft (or output shaft)
13. Low/High range coupling sleeve
14. Epicyclic reduction unit: low/high range selection
15. PTO output shaft
16. Layshaft (lower)
17. Forward gear constant mesh driven gear
18. Forward/reverse synchronized coupler
19. Reverse gear constant mesh driven gear
20. PTO constant mesh gear
21. PTO front bearing housing
22. Reverse speed idler gears
23. Transmission input shaft

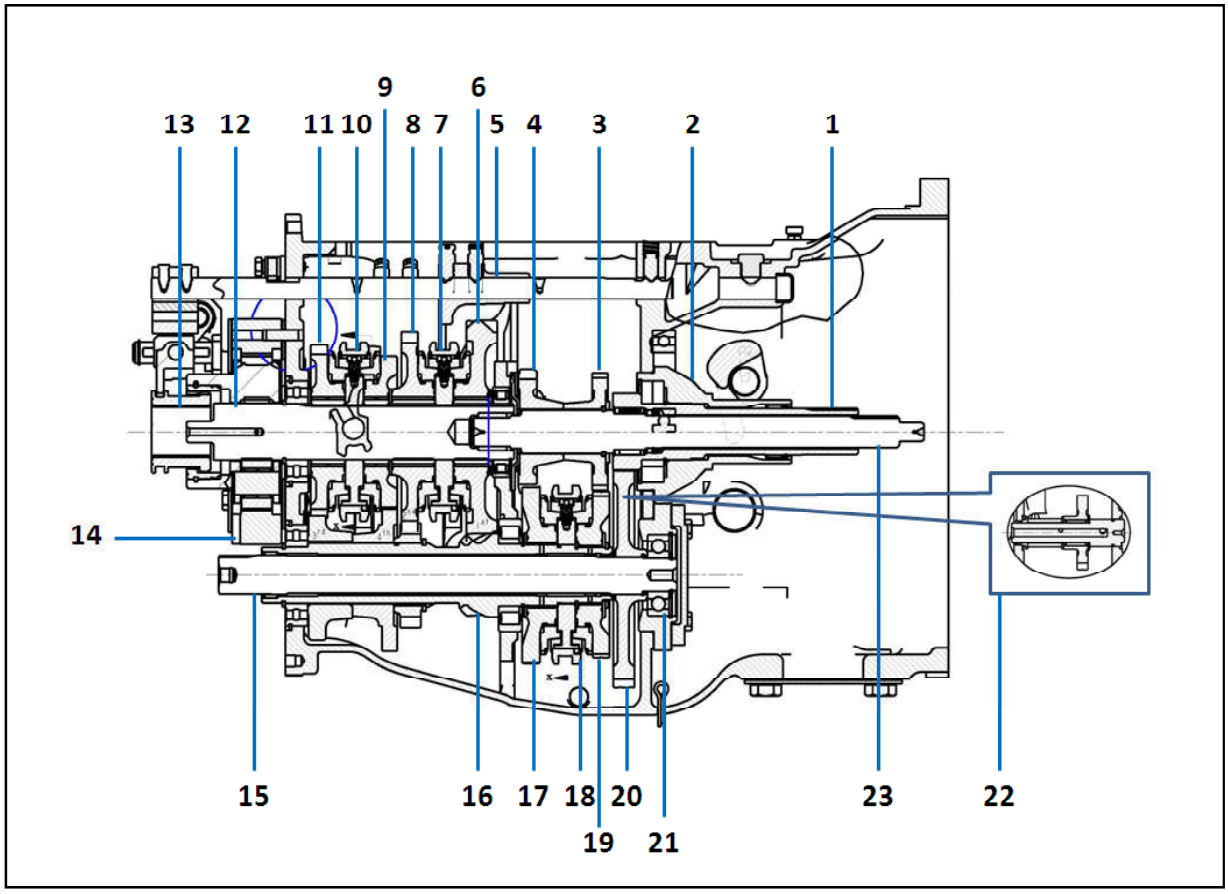


Fig 2
SIDE SHIFT

1. PTO input shaft and gear
2. Input shaft housing
3. Reverse gear constant mesh drive gear
4. Forward gear constant mesh drive gear
5. Selector rails and forks
6. 1st speed driven gear
7. 1st/2nd gear synchronized coupler
8. 2nd speed gear
9. 4th speed driven gear
10. 3rd/4th gear synchronized coupler
11. 3rd speed driven gear
12. Main shaft (or output shaft)
13. Low/High range coupling sleeve
14. Epicyclic reduction unit: low/high range selection
15. PTO output shaft
16. Layshaft (lower)
17. Forward gear constant mesh driven gear
18. Forward/reverse synchronized coupler
19. Reverse gear constant mesh driven gear
20. PTO constant mesh gear
21. PTO front bearing housing
22. Reverse speed idler gears
23. Transmission input shaft

Drive through the 1st, 2nd, 3rd and 4th ratio free running gears takes place when the selected gear is engaged with the mainshaft by a sliding coupler. The coupler located between the pairs of gears forms part of the synchromesh engagement mechanism. Ball and roller bearings are used to support the main and layshaft.

Gearbox Driveline

The order of drive through the gearbox, with the gears selected is as follows:

1. From the input shaft through the forward or reverse gear set to the layshaft.
2. From the layshaft to the selected free running gear on the mainshaft.From the free-running gear to the coupler.
3. From the coupler to the mainshaft via the coupler hub which is splined to the mainshaft.
4. From the mainshaft to the tractor's final drive arrangements via the epicyclic gear reduction unit in LOW range drive or directly in HIGH range.

Synchromesh mechanism:

The synchromesh mechanism synchronises (equalises) the speed of the selected free-running gear with the appropriate driven shaft before drive engagement. This is of great benefit to the drive by preventing potential gear damage and allowing fast, easy gear changes to be made on the move without the need to stop the tractor. Engaging gear with the tractor stationary is also easier.

CAUTION: The tractor MUST come to rest before changing direction from forward to reverse or reverse to forward.

Epicyclic gear reduction unit:

Up to this point only passing reference has been made to the epicyclic gear reduction unit at the rear of the gearbox. This is of normal-duty design.

The rear end of the mainshaft is machined to form the sun gear which meshes with three planet gears, also in mesh with a fixed internal ring gear or 'annulus' forming the circumference of the working components. When the mainshaft rotates, the planet gears and carrier revolve round the sun gear at a reduced speed compared with that of the mainshaft.

A sliding coupler with internal and external splines forms the connection between the gearbox and the drive shaft to the final drive. When moved forwards by its output lever, it couples the mainshaft directly to the output shaft to establish high range drive, giving the gearbox an additional set of speed ratios 5th, 6th, 7th, 8th and high reverse.

When shifted fully rearwards the external splines on the coupler engage corresponding splines on the planet carrier to establish low range drive. In these circumstances, drive from the gearbox mainshaft to the output shaft is via the carrier and subject to a speed reduction giving 1st, 2nd, 3rd and 4th speed ratios and low reverse. The coupler may also be placed in a mid or neutral position free of the mainshaft and carrier to totally disconnect the drive from the gearbox - a feature forming the basis of the Massey Ferguson neutral starting arrangements.

GEAR SHIFT LEVER ARRANGEMENT - CENTER SHIFT

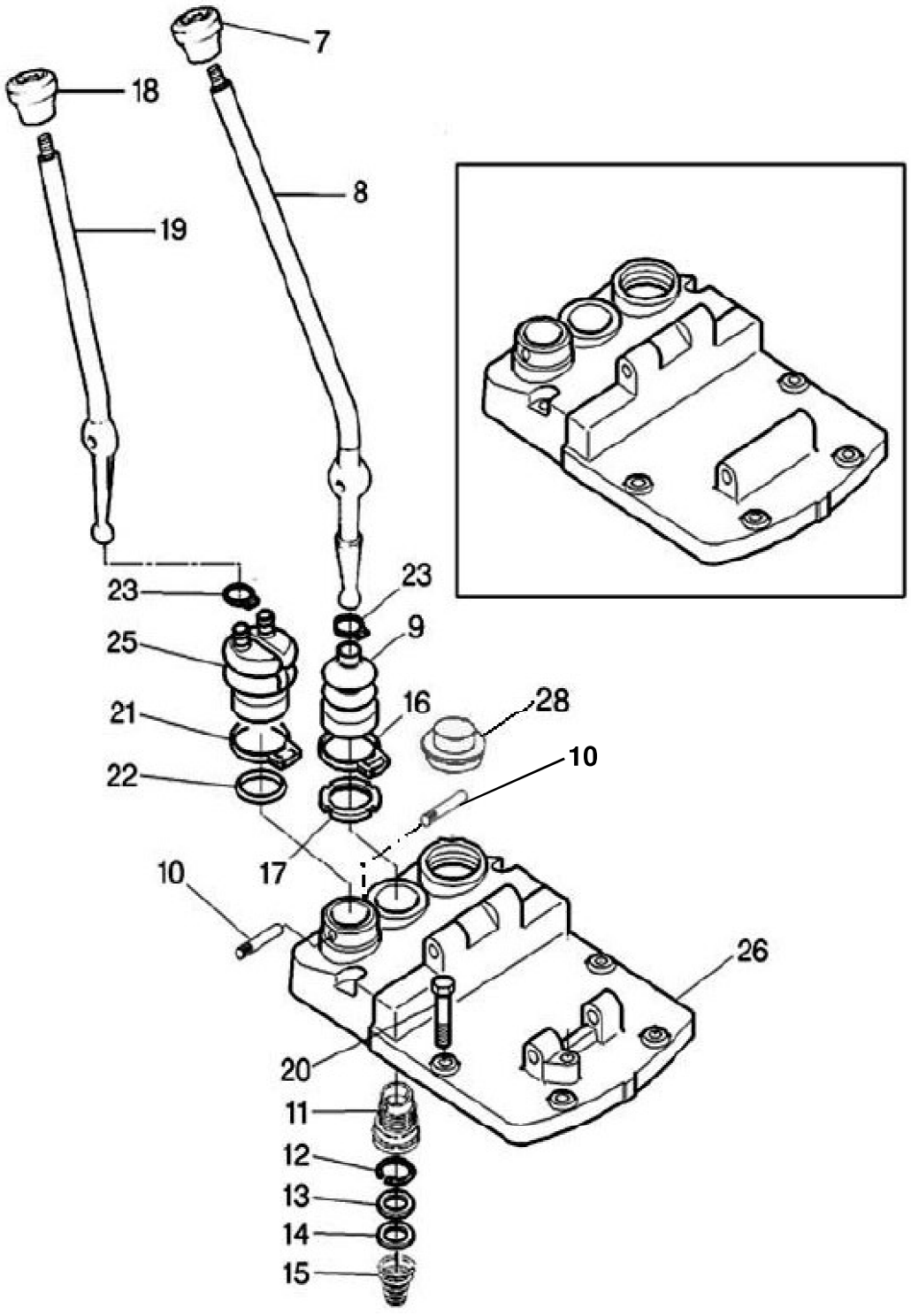


Fig 3

9B.3 GEAR SHIFT LEVERS - CENTER SHIFT

Removal and refitment

Removal

1. Remove the steering wheel, instrument panel and other parts necessary to gain access to the gearbox top.
2. Remove the split pin and clevis pin and disconnect the linkage from the forward/reverse gear lever.
3. Disconnect the hydraulic hoses to the hydrostatic steering unit.
4. Remove the Hydrostatic steering unit assembly.
5. Move all the gear levers into the neutral position.
6. Remove the bolts securing the top cover assembly to the gearbox(item 20 in fig 2).
7. Remove the assembly from the tractor and place on a work bench.

Main gear lever:

8. Remove the gear lever knob (item 7 in fig 2).
9. Remove the rubber cover(item 9 in fig 2).

WARNING: Spring under compression.

10. Turn the assembly over and unclip the spring retaining clip (item 12 in fig 2).
11. Remove the spring(item 15 in fig 2)
12. Remove the retaining pin(item 10 in fig 2).
13. Remove the main gear lever (item 8 in fig2).
14. Remove the gear lever cup and discard the 'O' ring. High/low and shuttle gear lever (item 22 in fig 2)
15. Remove the knob (item 18 in fig 2).
16. Remove the rubber cover (item 25 in fig 2).
17. Remove the retaining pin (item 10 in fig 2).
18. Remove the shuttle gear lever.
19. Remove the high/low gear lever (Item19 in fig 2).

Refitment:

20. Reverse procedures 1 to 19 except:

a. Replace the rubber covers to prevent dirt getting into the transmission.

b. Coat the underside of the cover with MF Instant Gasket (Loctite 515) and torque the cover bolts to 83 lbs.ft. (112 Nm).

c. Tighten the steering wheel nut to a torque of 35 lbs.ft. (47 Nm).

9B.4 GEAR SHIFT LEVERS - SIDE SHIFT

Removal and refitment

Removal

1. Park the vehicle on level ground and apply parking brake.
2. Pull the hood latch cable and lift the hood.
3. Disconnect the battery terminals
4. Remove the platform from the tractor, see operation 5.16 Foot step (page 5A - 14).
5. Check whether side shift in neutral position.
6. Remove the dipstick
7. Remove 4 bolts, 1 allen head screw and 1 nut in side shift cover
8. Remove M5 nut from side shiftcover
9. Disconnect the response lever by removing a cotter and a clevis pin.
10. Remove the side shift assembly from centre housing.
11. Keep the side shift assembly in suitable fixture.

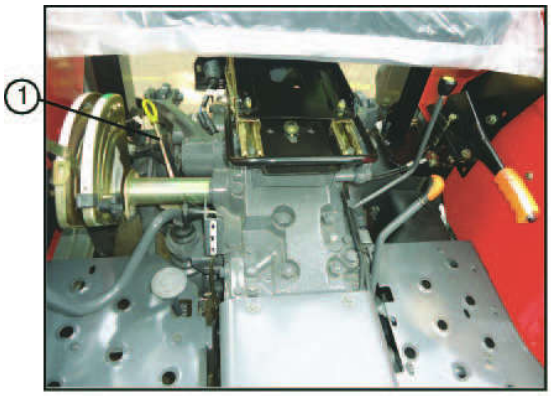


Fig 4

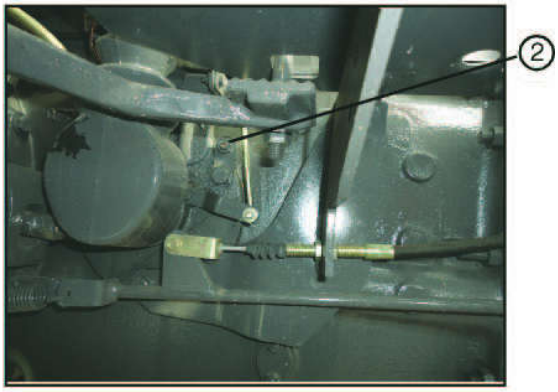


Fig 5

Fig 6

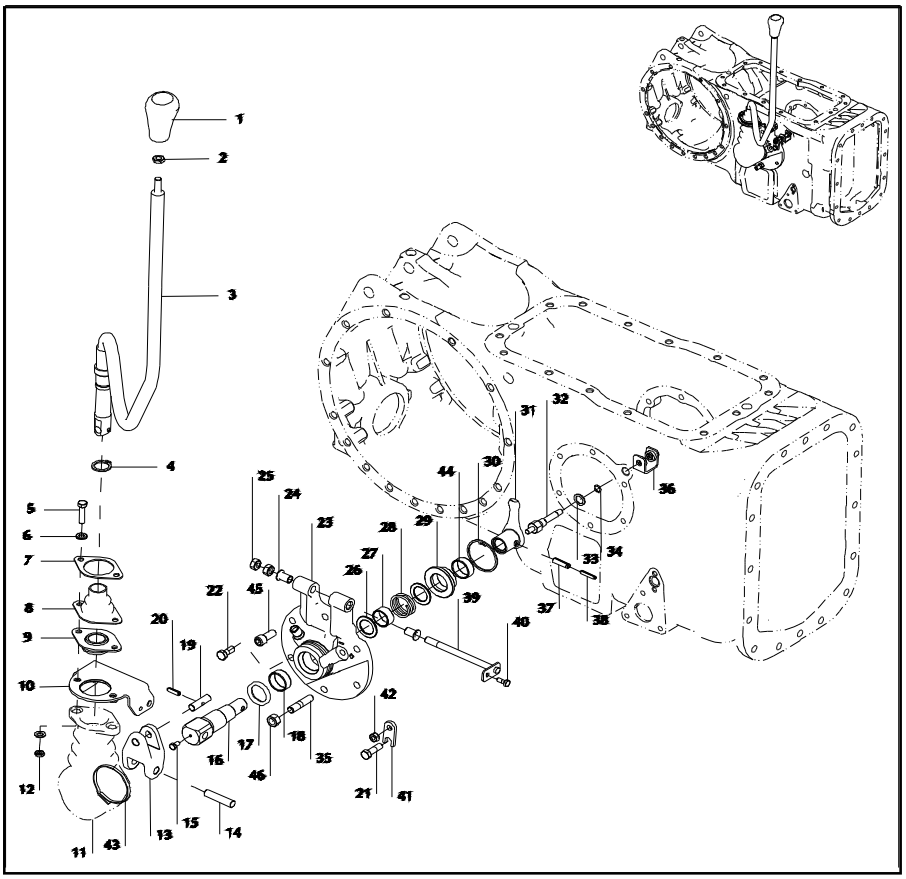


Fig 7

Removal - side shift Gear lever

1. Remove knob(1) and M5 nut(2).

2. Remove the strap(43) and slightly lift the rubber boot(11) for easy accessability.

3. Remove the spring pin(20) and pin (19).

4. Remove the M5 nut(25),M6 bolt(40) and pin assy(39).

5. Remove circlip(4),bolt(5),washer(6),and nut(12).

6. Remove the plate(7),boot(8),assembly ball(9), pivot plate(10) and rubber boot(11).

Removal - side shift housing

7. Remove the M6 bolt(15) and pin (14).

8. Remove the spring pin(38)(37) and selector pawl(31).

9. Remove the shaft(16).

10. Remove the pin (5) and remove the cam (6) and spring (7) - Refer fig: 9.

11. Remove the pin (13) and remove the lever (15), shaft (12) and washer (11) - Refer fig: 9.

12. Remove the circlip(30), bush(44) , collar(29), washer(26), spring(28) and spacer(27) .

13. Remove oil seal(17) and bush(18).

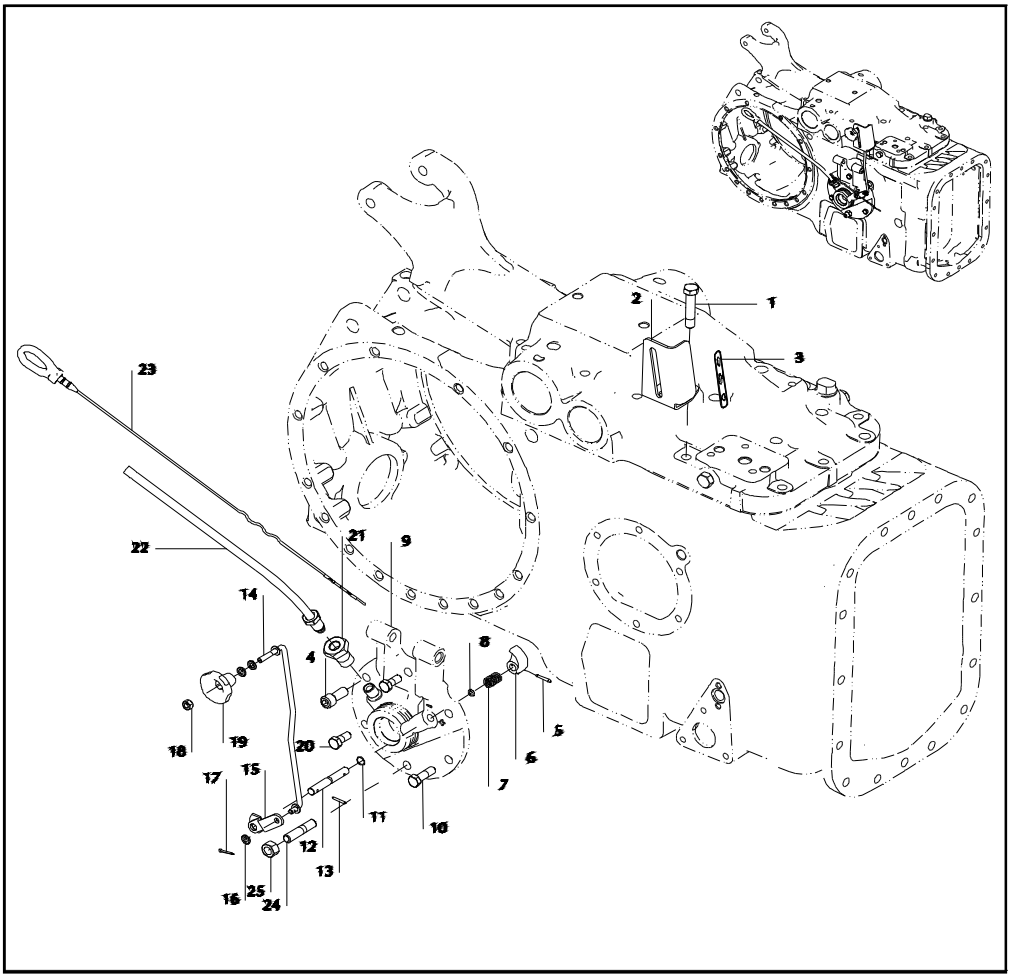


Fig 8

Refitment

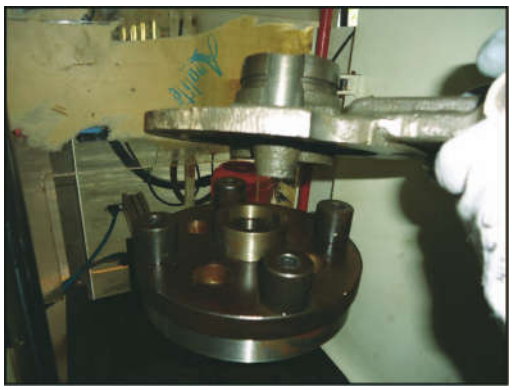
1. Place the collar on the table

2. Place the bush in the service tool (SER3000007) as shown

NOTE : Refer page no:45 for service tool details

3. Press the bush inside the collar using a hand press

4. Place the side cover housing on a suitable work bench as shown



Refitment

5. Place the service tool (SER3000007) on the side cover housing as shown

NOTE : Refer page no:45 for service tool details

6. Fix the seal on the service tool (SER3000007)

NOTE: The lip of the seal to be faced up

NOTE : Refer page no:45 for service tool details

7. Place the seal on the side cover housing and press using a hand press

8. Place the service tool (SER3000007) on the work bench as shown

NOTE : Refer page no:45 for service tool details

Refitment

9. Place the side shift cover housing on the tool

10. Place the spacer inside the side cover housing

11. Place the spring

12. Place the collar

NOTE: The collar to be placed inside the spring

Refitment

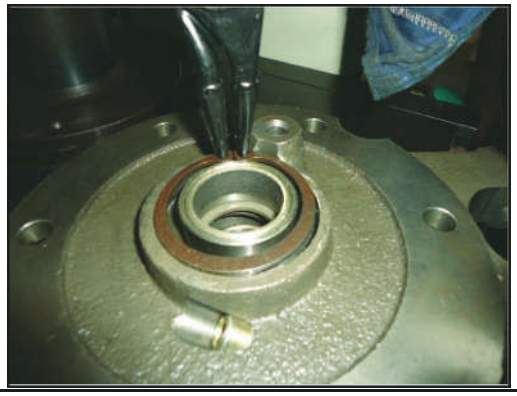
13. Assemble the washer over the spring

14. Assemble the bush on the side cover housing and place the service tool (SER3000007) as shown

NOTE : Refer page no:45 for service tool details

15. Press the assembly using a hand press

16. Secure the assembly with circlip



Refitment

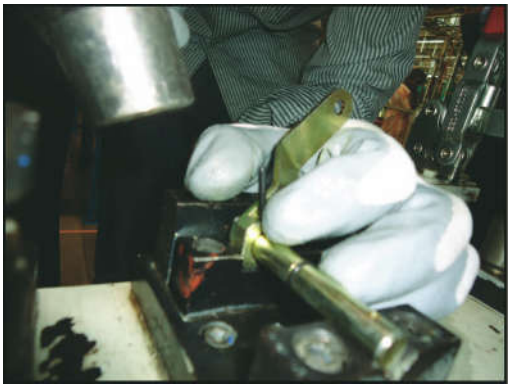
17. Assemble the O ring on the repnse cover shaft

18. Assemble the response cover shaft with response lever

NOTE: Match the holes of response cover shaft and response lever

19. Place the assembly in a suitable vice

20. Secure the responsed cover shaft with response lever using a spirol pin

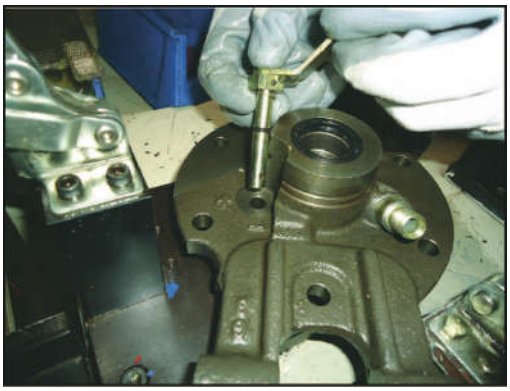


21. Assemble the ring with the response assembly

Refitment

22. Place the side cover housing in a suitable vice

23. Assemble the resonse lever assembly with side cover housing and hammer using a mallet



24. Turn the side cover housing and place in a suitable vice

25. Assemble the spring on the response cover shaft

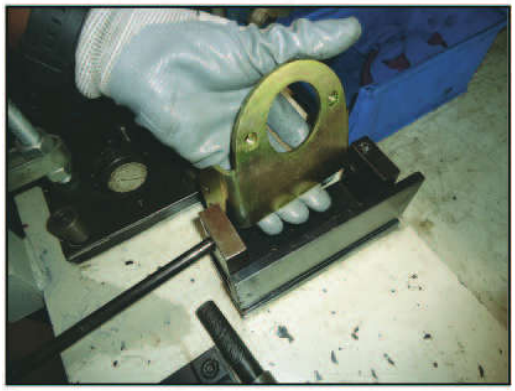
26. Assemble the cam on the response cover shaft

Refitment

27. Align the hole in the cam with hole in response cover shaft by applying little force on the cam

28. secure using a spirol pin

29. Place the pivot plate in a suitable vice and secure it properly



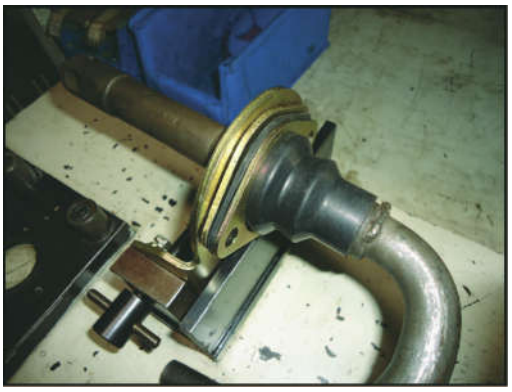
30. Assemble the ball & housing assembly with gear shift lever

Refitment

31. Assemble the gear shift lever with the pivot plate

32. Assemble the rubber boot with the gear shift lever

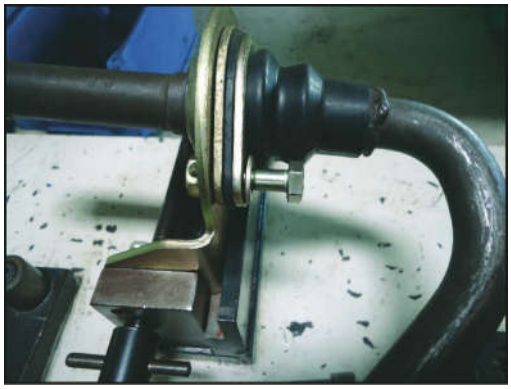
33. Assemble the clamp plate with gear shift lever



34. Secure the gear shift lever with pivot plate using a retaining ring.

Refitment

35. Secure the gear shift lever assembly with pivot plate using two bolts



36. Align side shift with synchro pivot block and secure using a solid pin

37. secure the solid pin with a hex bolt

38. Place the side cover housing on a suitable vice
39. Apply grease on the side shift shaft
40. Position the side shift shaft assembly with the side cover housing

Refitment

41. Place the side cover housing on a suitable vice

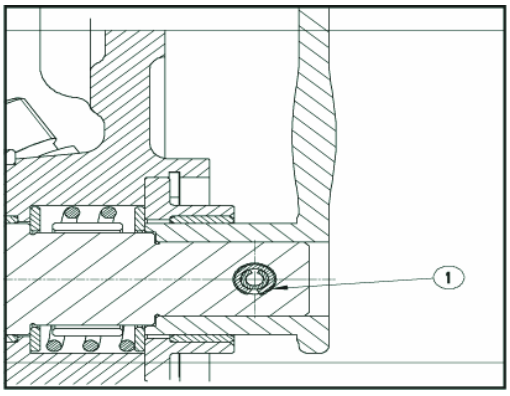
42. On the rear side of the side cover housing, assemble the selector pawl with the side shift shaft

43. Align the holes of selector pawl and side shift housing and secure using a spirol pin

44. Double secure the assembly with another spirol pin which have smaller diameter than the previous.

NOTE: Ends of the both spirol pin should be placed diametrically opposite to each other

45. Spring dowel to be assembled as shown



Refitment

46. Assemble the rubber boot with gear shift lever assembly

47. Secure the assembly using bolt & nut

48. Assemble the gear shift assembly with side cover housing assembly by aligning the holes of gear shift lever and synchro block

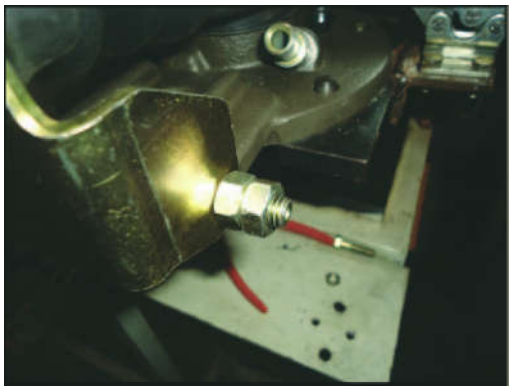
49. Secure using a solid pin

50. Align the hole of solid pin with gear shift lever and secure using a spirol pin

Refitment

51. Fix the pivot plate with side cover housing using pin assembly

52. Secure with two bolts



53. Secure the rubber boot using a plastic strap

54. Tighten all the fastners

55. Assemble the Side shift sub assembly to the tractor

PLANETARY LEVER (HIGH-LOW GEAR LEVER)

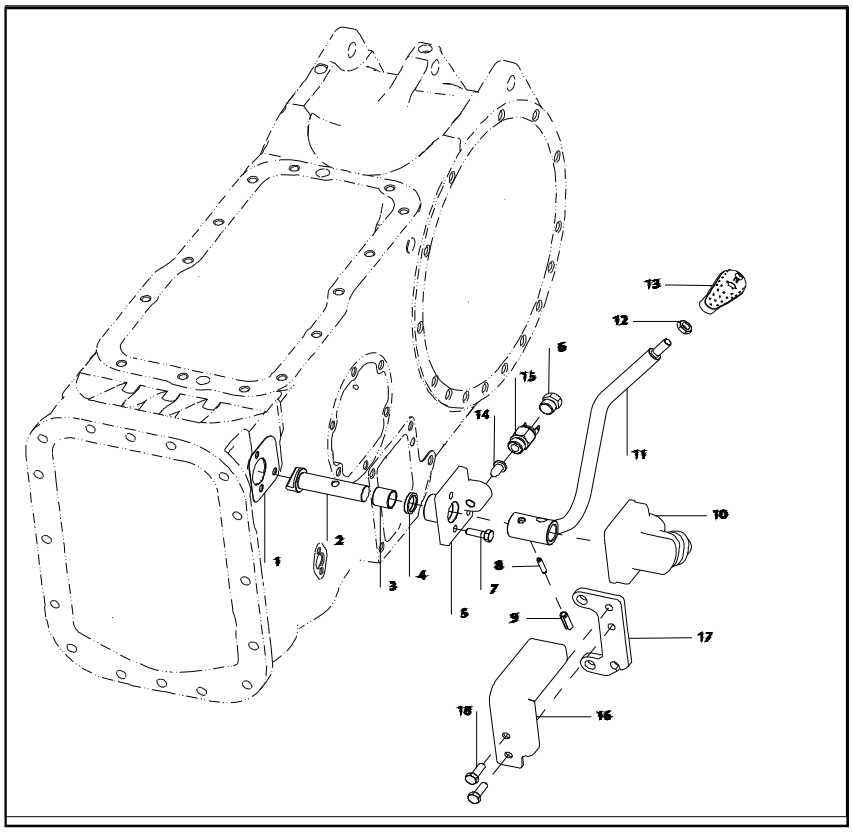


Fig 9

Removal and refitment

Removal

1. Park the vehicle on level ground and apply parking brake.
2. Pull the hood latch cable and lift the hood.
3. Disconnect the battery terminals
4. Remove the LH platform from the tractor, see operation 5.16 Foot step (page 5A - 14) .
5. Ensure planetary lever in neutral position.
6. Remove the knob(13) and nut(12)
7. Disconnect electrical connection from nuetral safety switch.
8. Remove plug(6),
9. Remove the nuetral safety(15) and ejector pin(14)-(FOR 8x2 ONLY)
10. Slightly adjust the rubber boot(10) and remove 3 precoated sealant screw.
11. Remove the planetary lever assembly from centre housing.
12. Remove the boot(10),spring pin(9)(8) and lever(11).
13. Remove the shaft(2),bush(3),oil seal (4) from housing planetary(5).

Refitment

1. Place the planetary housing on the service tool (SER3000007)

NOTE : Refer page no:45 for service tool details

2. Place the bush on the service tool (SER3000007)

NOTE : Refer page no:45 for service tool details

3. Press the bush to the planetary housing using hand press

4. Place the seal in the service tool (SER3000007)

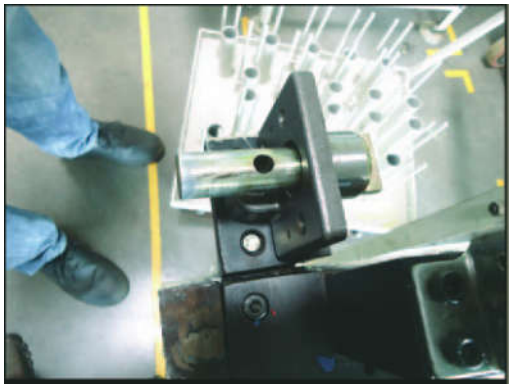
NOTE: The lip of seal to be faced upside

NOTE : Refer page no:45 for service tool details

Refitment

5. Press the seal in the planetary housing using hand press

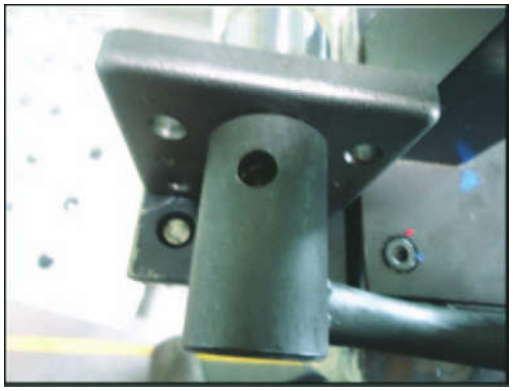
6. Place the planetary lever shaft inside the planetary housing



7. Assemble the planetary shift lever with shaft planetary lever

Refitment

8. Align the hole of planetary shift lever and shaft planetary lever



9. Secure using a spirol pin

10. Assemble the planetary lever sub assembly to the tractor

9B.5 SHUTTLE CONTROL LEVER

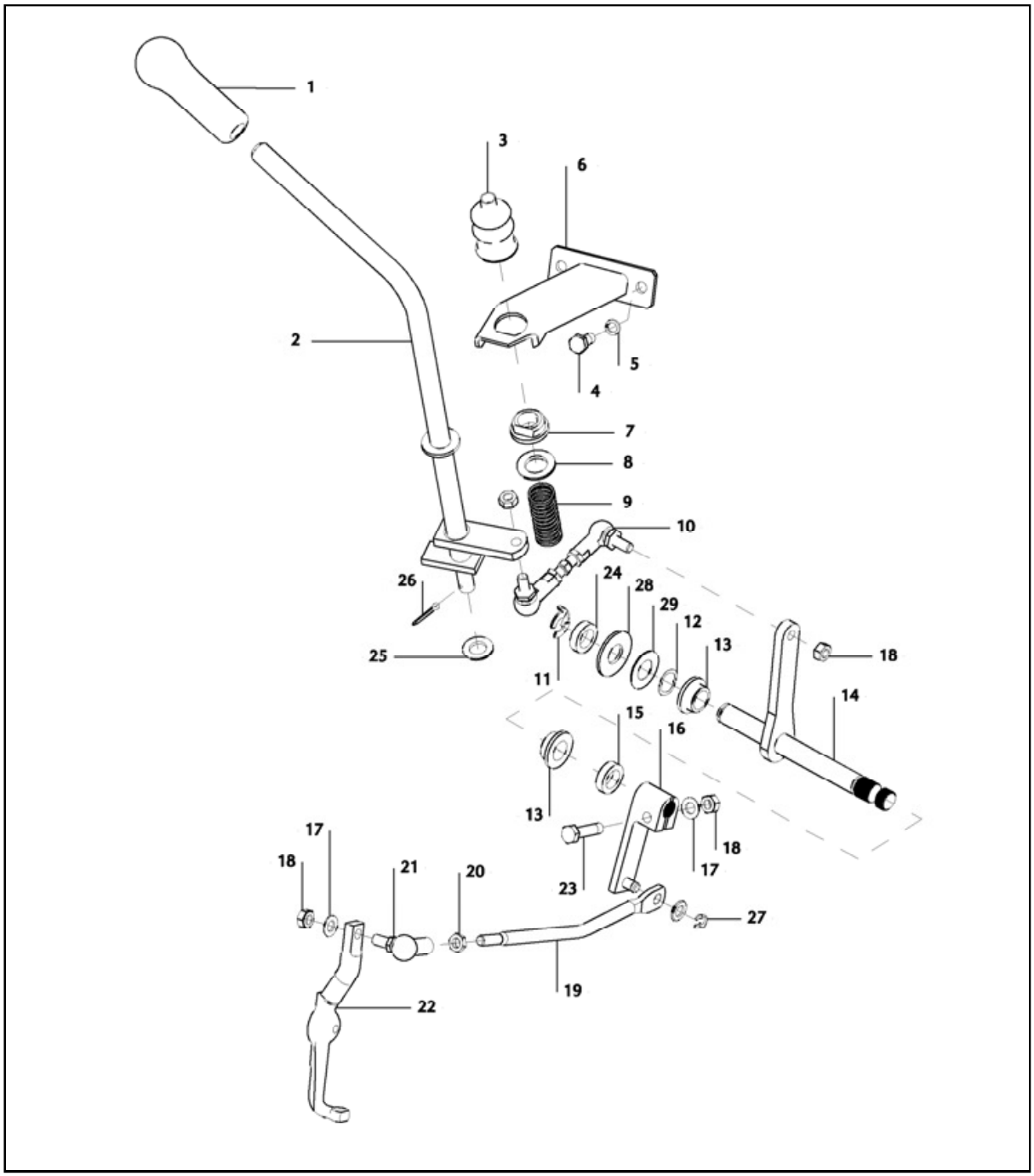


Fig 10

9B.6 FORWARD/REVERSE (SHUTTLE) CONTROL LEVER

Overhaul

Dis-assembly

1. Remove the lower instrument panel. Gear lever
2. Remove hand grip from the lever(Item 1 in fig 3).
3. Unscrew and remove the hand grip.
4. Remove the nut securing the upper link to the gear lever (item 9,12 in fig 3).
5. Remove the Split from the base of the gear lever (Item 10 in fig 3).
6. Lift the gear lever up out of its bracket and then draw the lever downwards through the upper instrument panel (item 3 in fig 3).
7. Remove the plastic cover from the lever (item 5 in fig 3).
8. Remove the bearing , washer and spring (item 6,7,8 in fig 3).

Cross-shaft

9. Remove the nut retaining the lower link to the gearbox (item 9, 28 in fig 3).
10. Remove the spring clip, washer and lower link (Item 33,34,28 in fig 3).
11. Disconnect the hand throttle control cable.
12. Remove the two bolts securing the throttle control bracket and move it to one side so that access can be made to the cross shaft.
13. Remove the nut and bolt and slide the lever off the shaft (Item 9, 23 in fig 3).
14. Remove the washer and bush (Item 19,20 in fig 3).
15. Remove the spring clip and bush (item 17,7,35,18,19 in fig 3).
16. Slide the cross-shaft to the right and by tilting it work it up out of the orbitrol support bracket (item 27 in fig 3).
17. Remove the nut and upper link (item 9,12 in fig 3).

Re-assembly

18. Reverse procedures 1 to 17 except:

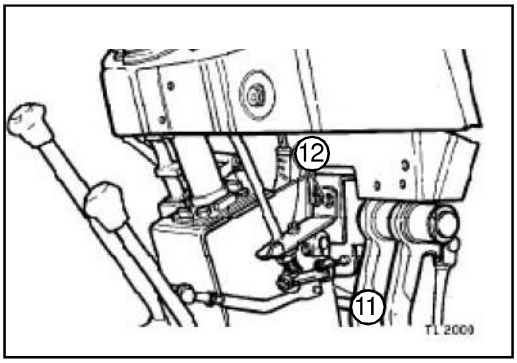


Fig 11

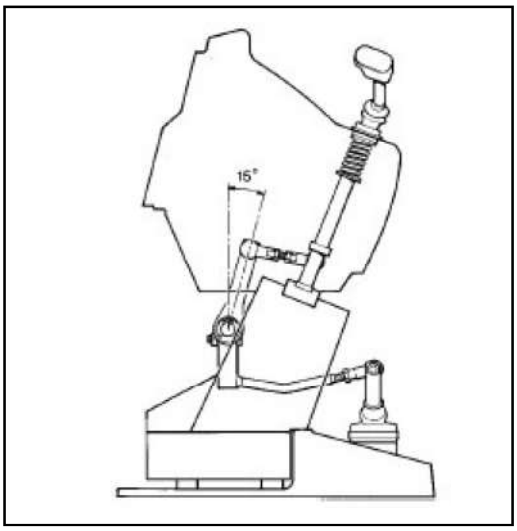


Fig 12

a. Lubricate all the shift lever bearings and thrust faces with general purpose grease when refitting.

b. Ensure that no electrical wiring or harness rubs or touches any moving part of the linkage.

c. Set the length of the upper link to 2.952 inch (75mm) between ball joint centres. Refit the cross shaft before assembly.

d. When refitting the cross-shaft and linkage the following points must be observed:

i. Put the gearbox forward/reverse (shuttle) lever in neutral.

ii.Connect up the upper link (12).

iii. Place the gearbox lever in neutral.

iv. Place the splined lever (24) onto the shaft so that there is a 15° angle between the two levers as shown in the illustration.

v. Make any adjustments to the lower link.

9B.7 SELECTOR RAILS AND FORK - CENTER SHIFT

Removal and refitment

Special Tools:

MF.414A Centralising pin and locating peg

Removal

WARNING: Beware of sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer housing or the centre housing and remove the gearbox,
2. Remove the gearbox top cover.
3. Remove all the locking wires and discard.
4. Remove the bolts, ball, spacer, and stop plate of the gear shift interlock mechanism.
5. Lift out the detent springs and plungers.
6. Loosen the locking screws.
7. Slide the 3rd/4th rail rearwards out of the housing.

   NOTE: When removing the selector rails, retain the gear lever selector jaws.
8. Loosen the locking screw.
9. Slide the 1st/2nd rail rearwards out of the housing and lift out the selector jaw.
10. Loosen the locking screw.
11. Slide the forward/reverse rail rearwards out of the housing.
12. Slide the high/low rail rearwards and remove the coupler.
13. Rotate the high/low rail through 90°.
14. Loosen the locking screw.
15. Slide the rail rearwards out of the casting.
16. Remove 1st/2nd and 3rd/4th selector forks.
17. Remove main input shaft, see operation 9B.8.
18. Remove the reverse idler assembly, see operation 9B.10 paragraph 9.
19. Remove the forward/reverse synchromesh selector fork.

Refitment

20. Reverse procedures 1 to 19 except:

a. Apply a few drops of oil to the selector rails before refitment.

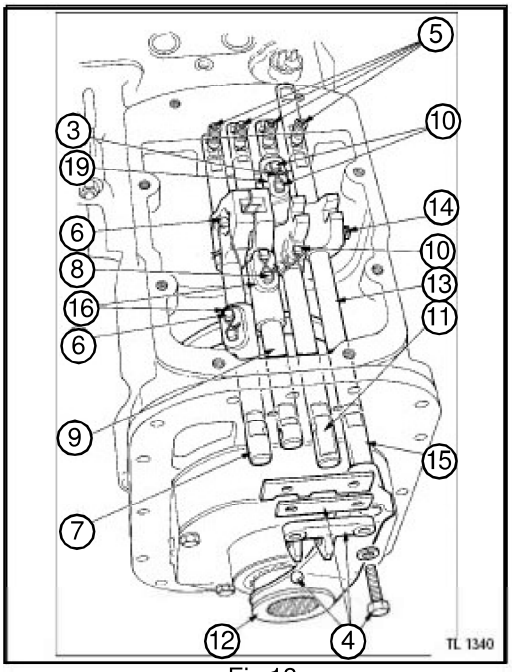


Fig 13

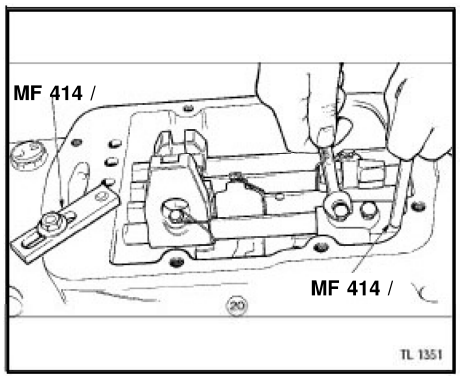


Fig 14

b. Set each synchromesh selector fork and rail to the neutral position. Lock the selector rail using the plate and bolt MF.414A/2 (part of tool MF.414A). Insert the centralising pin, MF.414A/1 into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler and hub. Progressively lock up the two security screws on the selector fork to 32 lbs.ft. (44 Nm). Afterwards, check that the centralising pin MF.414A/1 can be removed freely.

c. Wire-lock all locking screws using new locking wire.

d. Tighten the high/low selector fork and selector block screws to a torque of 32.lbs.ft. (44 Nm)

e. On completion of the refitting procedure, place all the gears in the neutral position.

f. Torque the interlock mechanism retainingscrews (4) to 32 lbs.ft. (44 Nm).

9B.8 SELECTOR RAILS AND FORK - SIDE SHIFT

Removal and refitment

Special Tools:

MF.414A Centralising pin and locating peg

Removal

WARNING: Beware of sharp edges around the top of the gearbox case.

1. Split the tractor between the gearbox and the spacer housing or the centre housing and remove the gearbox,
2. Remove the gearbox top cover.
3. Remove all the locking wires and discard.
4. Remove the bolts, ball, spacer, and stop plate of the gear shift interlock mechanism.
5. Lift out the detent springs and plungers.
6. Loosen the locking screws.
7. Slide the 3rd/4th rail rearwards out of the housing.

   NOTE: When removing the selector rails, retain the gear lever selector jaws.
8. Loosen the locking screw.
9. Slide the 1st/2nd rail rearwards out of the housing and lift out the selector jaw.
10. Loosen the locking screw.
11. Slide the forward/reverse rail rearwards out of the housing.
12. Slide the high/low rail rearwards and remove the coupler.
13. Rotate the high/low rail through 90°.
14. Loosen the locking screw.
15. Slide the rail rearwards out of the casting.
16. Remove 1st/2nd and 3rd/4th selector forks.
17. Remove main input shaft, see operation 9B.8.
18. Remove the reverse idler assembly, see operation 9B.10 paragraph 9.
19. Remove the forward/reverse synchromesh selector fork.

Refitment

20. Reverse procedures 1 to 19 except:

a. Apply a few drops of oil to the selector rails before refitment.

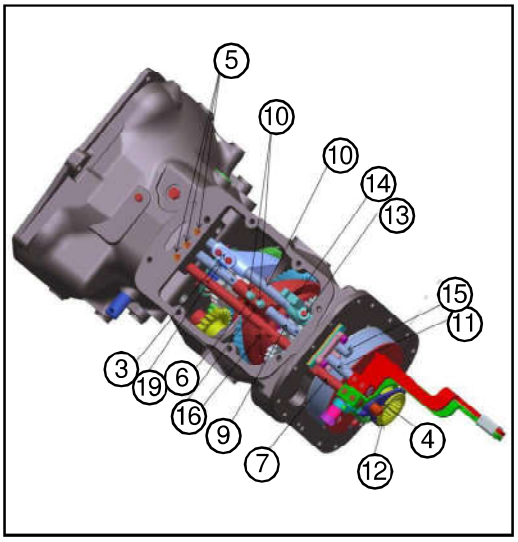


Fig 15

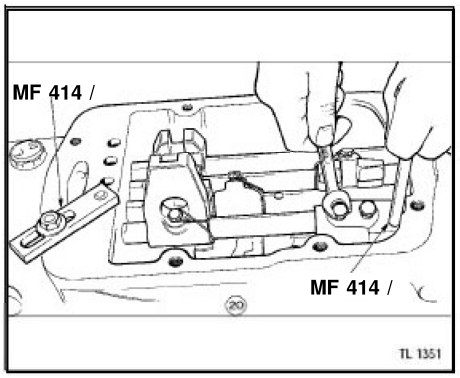


Fig 16

b. Set each synchromesh selector fork and rail to the neutral position. Lock the selector rail using the plate and bolt MF.414A/2 (part of tool MF.414A). Insert the centralising pin, MF.414A/1 into the hole on the top of the selector fork, lining it up with the corresponding hole in the sliding coupler and hub. Progressively lock up the two security screws on the selector fork to 32 lbs.ft. (44 Nm). Afterwards, check that the centralising pin MF.414A/1 can be removed freely.

c. Wire-lock all locking screws using new locking wire.

d. Tighten the high/low selector fork and selector block screws to a torque of 32.lbs.ft. (44 Nm)

e. On completion of the refitting procedure, place all the gears in the neutral position.

f. Torque the interlock mechanism retainingscrews (4) to 32 lbs.ft. (44 Nm).

9B.9 NORMAL-DUTY EPICYCLIC UNIT - CENTER SHIFT

Removal and refitment

Removal

1. Split the tractor between the gearbox and the spacer or centre housing,
2. Remove the locking wire and discard.
3. Remove the locking screw.
4. Remove the selector fork and coupling.
5. Remove the bolts.
6. Remove the complete assembly.

Refitment

7. Reverse procedures 1 to 6 except:

   a. Ensure that the front and rear thrust rings are correctly located before refitment.

   b. Ensure that the dowels are correctly located in the gearbox casing.

   c. Locate the cover plate with the cut out, to the bottom left hand corner.

   d. Fit a lockwasher to the lower right hand retaining bolt.

   e. Tighten the retaining bolts progressively and evenly to a torque of 32 lbs.ft. (44Nm)

   f. Tighten the selector fork lock screw to a torque of 32 lbs.ft (44 Nm).

   g. Wire lock all fixings affected by procedure 2 using new locking wire.

Fig 17

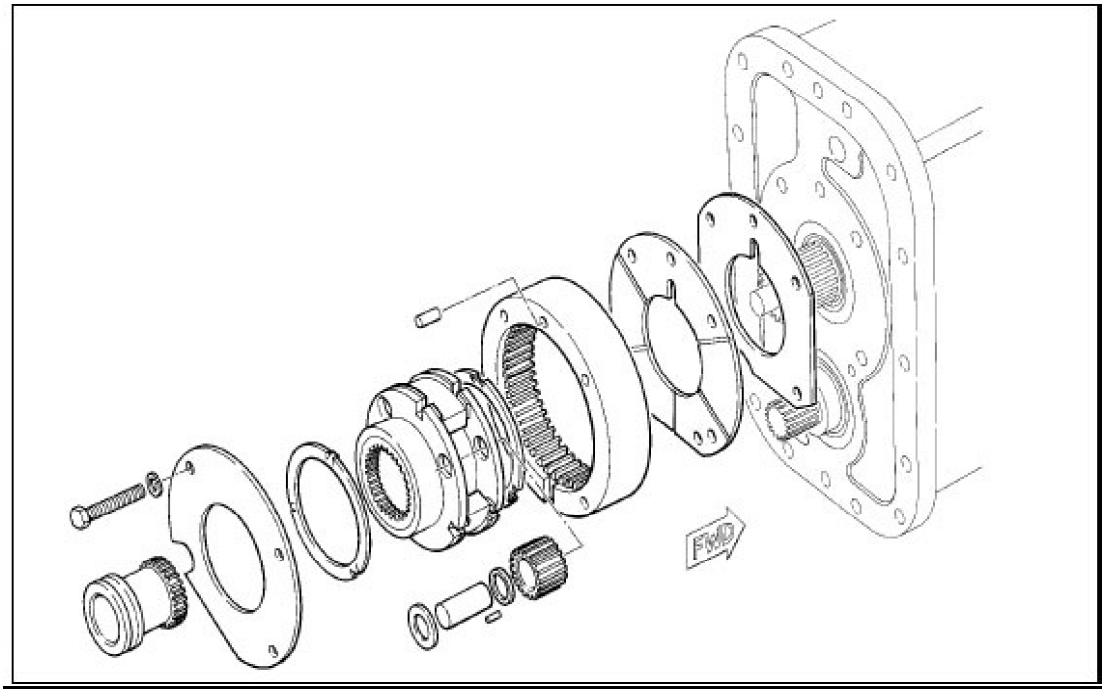


Fig 18

9B.10 NORMAL-DUTY EPICYCLIC UNIT - CENTER SHIFT

Overhaul

Dis-assembly

1. Remove the gearbox epicyclic unit, see operation 9B.6 .
2. Remove the rear plate.
3. Remove the rear thrust ring.
4. Remove the planetary pinion carrier.
5. Remove the front thrust ring.
6. Remove the shim.
7. Remove the front plate.
8. If necessary remove the two dowels from the ring gear.
9. Press each shaft out of planetary pinions and carrier.
10. Retain the three spacers, two thrust washers and needle roller bearings from each pinion.

Examination:

Clean and carefully examine all the components,especially those subject to movement, and replace any items that show signs of damage or wear.

Re-assembly

11. Replace the needle rollers in each pinion, a smear of petroleum jelly, NOT GREASE, will help to retain them. There are two rows of 27 rollers to each pinion.
12. A spacer is fitted between each row of needle roller bearings and at each end of the pinion.
13. Fit a thrust washer to each side of the pinions.
14. To assist assembly of the front and rear thrust rings on the planetary pinion carrier, smear them with petroleum jelly,NOT GREASE. Ensure that the tabs on the thrust rings locate in the pinion carrier cut-outs, and the brass faces are fitted away from the planetary pinion carrier.
15. The front and rear plates have oil grooves which must be fitted towards the planetary pinion carrier.
16. Only one shim is fitted.

9A.11 EPICYCLIC UNIT - SIDE SHIFT

Removal and Refitment

Special Tools:

SER / 054 : Tractor splitting stand.

Removal

1. Split the tractor between centre housing and transmission.
2. Remove the 4 mounting bolts of ring gear. (Item 1 in Fig 17).
3. Remove the circlip (Item 23 in Fig. 18).
4. Remove the plunger (Item 21 in Fig. 18), Fork-planetary (Item 22 in Fig. 18), selector shaft planetary (Item 24 in Fig. 18) and Bush HI/LOW (Item 25 in Fig. 18).
5. Remove Selector-planetary (Item 27 in Fig. 18), Slotted pins (Items 28, 29 in Fig. 18).
6. Remove the Assembly bracket planetary (Item 26 in Fig. 18).
7. Remove the rear cover plate. (Item 14 in Fig 18).
8. Remove epicyclic carrier with rear and front thrust washers.

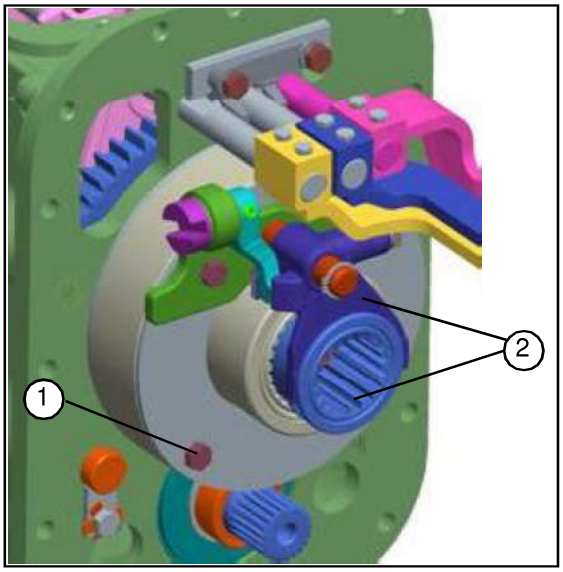


Fig. 19

9. Gently tap out the ring gear. (Item 5 in Fig. 18).
10. Remove the front cover plate and shim. (Item 1,3 in Fig. 18).
11. If necessary, remove the pin dowels from the ring gear. (Item 7 in Fig. 18).

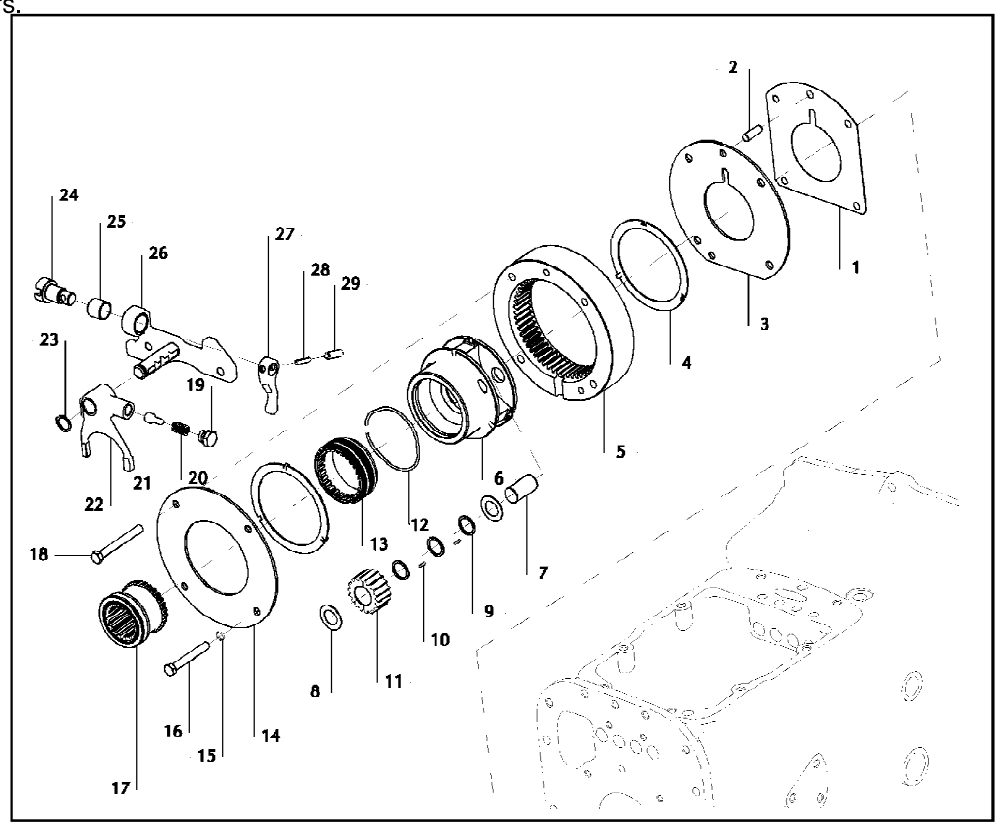


Fig. 20

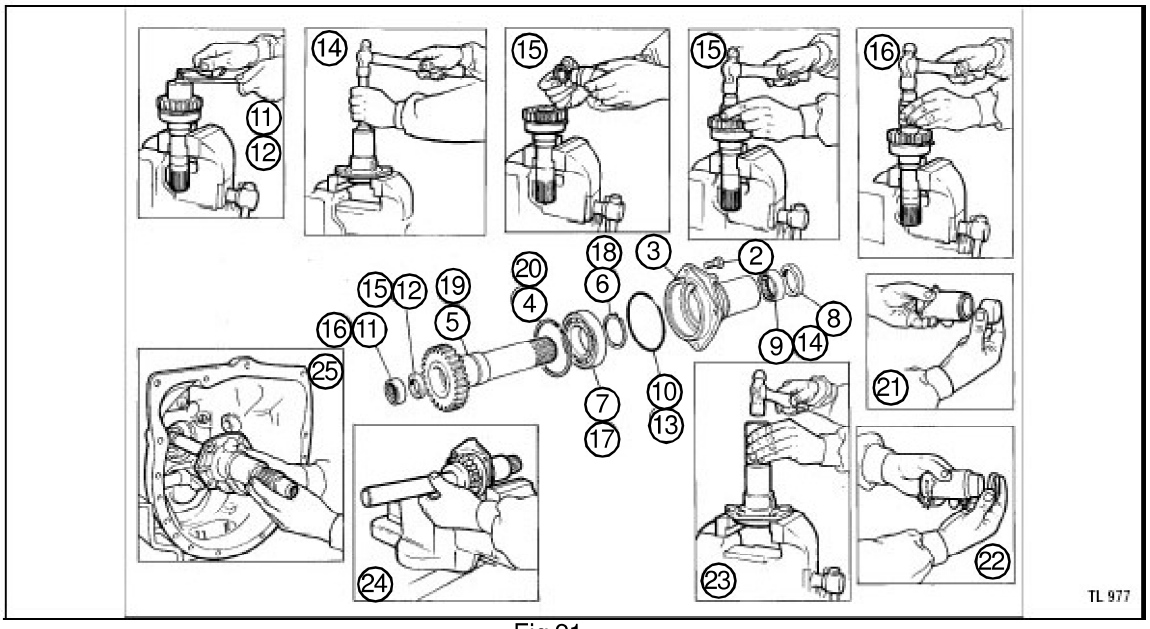


Fig 21

9B.12 INPUT SHAFTS AND HOUSING

Removal and refitment

Special Tools:

MF.255B	PTO input shaft oil seal replacer
MF.315 A	Needle roller bearing remover
MF.421	Needle roller bearing and seal replacer
MF.422A	Needle roller bearing and seal remover.
MF.177A	Input shaft seal sleeve

Removal

1. Remove the clutch release mechanism,see operation 9A.6 .
2. Remove the four bolts.
3. Withdraw the input housing complete leaving the main input shaft in position.
4. Remove the large internal circlip.
5. Push the PTO input shaft, complete with bearing, rearwards out of the housing.
6. If necessary remove the circlip.
7. If necessary press the bearing off the shaft.
8. Lever the seal out of the front of the housing.
9. Using MF.315A, drive the needle roller bearing from the front of the housing.
10. Remove the 'O' ring from the housing.
11. Using MF.422A, carefully remove the needle roller bearing from the inside of the PTO input shaft.
12. Using MF.422A, remove the oil seal from the PTO input shaft.

Refitment

13. Fit a new 'O' ring into the housing.
14. Using MF.315A, replace the needle roller bearing in the housing.
15. Using MF.421, fit a new seal into the input shaft with the lip of the seal facing the tool.
16. Using MF.421, refit the needle roller bearing into the input shaft with the round end of the cage to the bottom of the recess.
17. Refit the bearing onto the outside of the shaft with the shield towards the gear teeth.
18. Refit the circlip. (Check that it is properly seated.)
19. Refit the PTO input shaft and bearing into the input housing.
20. Refit the circlip. (Check that it is properly seated.)
21. Ensure that the nylon cone is in place on the seal replacer MF. 255B.
22. Place the seal over the cone and onto the tool with the seal lip facing away from the tool and remove the nylon cone.
23. Place the tool over the PTO input shaft and tap the seal into place.
24. Place seal protector sleeve MF.177A over the main input shaft on the gear box.
25. Carefully refit the input housing over the input shaft and withdraw the protector sleeve when the housing is in place.
26. Reverse procedures 2 to 7, except:

    a. Use petroleum jelly, NOT GREASE, to lubricate all seals and the needle roller bearing when refitting.

    b. Lightly coat the bolt thread with Hylomar sealant when refitting and tighten the bolts to a torque of 43 lbs.ft. (58 Nm).
27. Refit the clutch release mechanism, see operation 9A.6 .

9B.13 PTO DRIVE SHAFT FRONT BEARING

Removal and refitment

Special Tools:

MF.218B PTO Drive Shaft Puller.

Removal

1. Remove the clutch release mechanism, see operation 9A.6.
2. Remove the four bolts and washers.
3. Remove the cover plate.
4. Remove the external circlip and washer.
5. Screw two 3/8 UNC x 3 inch (part of MF.218B) bolts into the bearing housing and tighten them evenly to draw the housing from the case and shaft.
6. Remove the housing.
7. Remove and discard the circlip.
8. Press out the bearing.
9. Remove and discard the 'O' ring.
10. Remove and discard the gasket.
11. If the gearbox has been removed and it is necessary to remove the PTO shaft, insert a 7/16 inch UNF bolt approximately 3-4 inch long into the shaft to protect it, drive the shaft out of the PTO constant mesh gear.

Refitment

12. Lightly coat the new gasket with Hylomar sealant.
13. Using MF.218B, refit the bearing and housing assembly.
14. Check that the PTO drive shaft splines locate with those in the PTO constant mesh gear, if the shaft has been removed.
15. Screw the centre screw into the end of the PTO shaft with the aid of a 9/16 inch across flats spanner.
16. Locate the bearing and housing assembly on the end of the PTO shaft and to the housing with the two long bolts provided with MF.218B through the unthreaded holes.
17. Place the adaptor onto the centre screw with the hollow face against the bearing.
18. Place the washer on the centre screw and put on the nut.

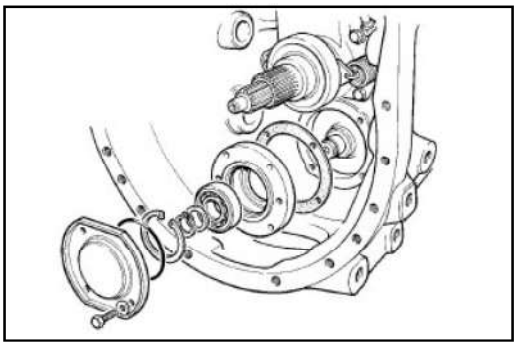


Fig 22

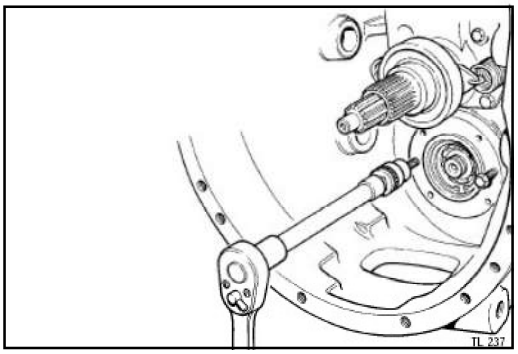


Fig 23

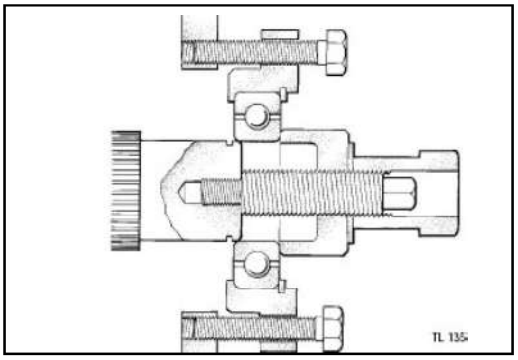


Fig 24

19. Tighten the nut with a 1 1/8 inch across flats spanner until the housing is pushed home and the PTO shaft is drawn through the ball bearing sufficiently to enable the washer and circlip to be fitted.
20. Fit a new circlip and washer.
21. Replace the cover ensuring that a new 'O' ring is fitted.
22. Lightly coat the securing bolt threads with Hylomar sealant.
23. Tighten the bolts to a torque of 43 lbs.ft. (58 Nm).

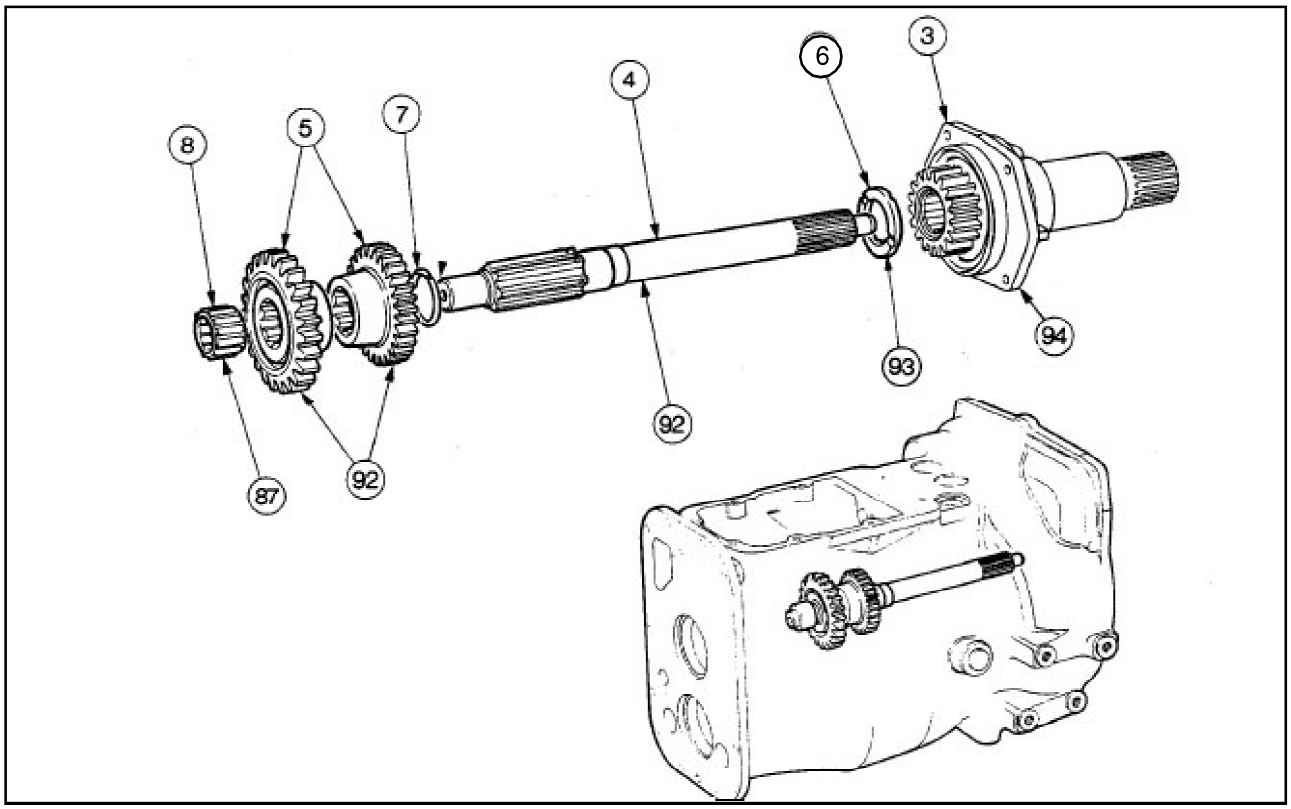


Fig 25

9B.14 LAYSHAFT, MAINSHAFT, PTO SHAFT AND GEARS

Overhaul

Special Tools:

MF.415 Synchromesh hub assembly tool

MS.550 Drive handle

Dis-assembly

With the gearbox removed from the tractor:

1. Remove the clutch cross-shaft and lever, see operation 9A.6 .
2. Remove the selector rails and forks, see operation 9B.5 .

NOTE: *The layshaft selector fork cannot be removed at this stage. Input shafts and housing*

3. Remove the input shaft and housing, see operation 9B.8 .
4. Withdraw the main input shaft.
5. Lift out the forward and reverse constant mesh gears.
6. Remove the main thrust washer.
7. Remove the snap ring and thrust washer from the main input shaft, if necessary.

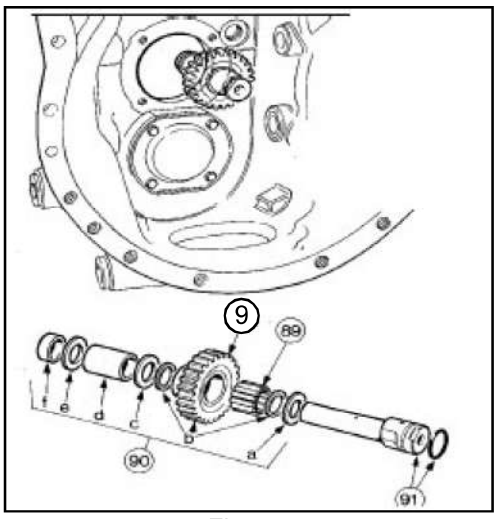


Fig 26

8. Remove the needle roller bearing from inside the main shaft.

Reverse Idler

9. Remove the reverse idler shaft by easing it out of the front of the gear box with a screw driver between the inner spacer and the casing, be careful, the idler gear contains loose needle roller bearings. Retain the components in a clean container.

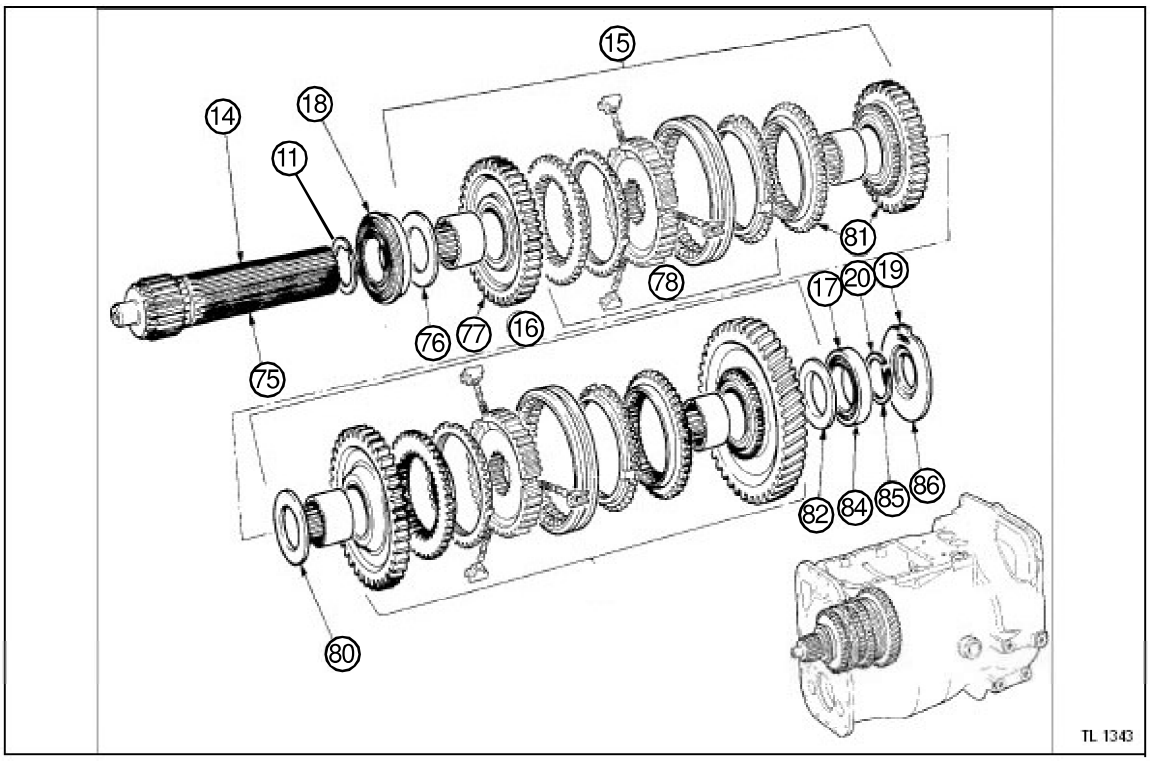


Fig 27 Main shaft

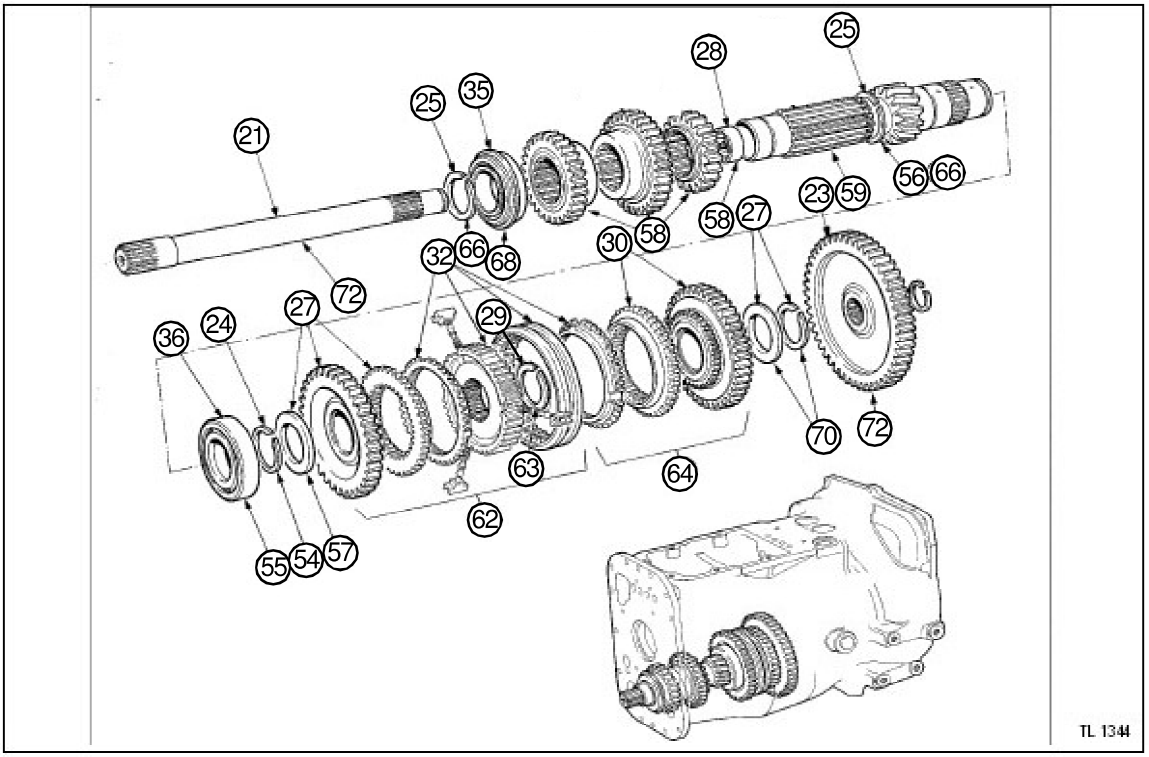


Fig 28 Lay shaft

Mainshaft

10. Lightly drive the front roller bearing to the rear with a punch to facilitate removal of the main shaft snap ring.
11. Remove the snap ring from the front of the main shaft.
12. Remove the epicyclic reduction unit from the rear of the gearbox, see operation 9B.6 .
13. Push the front main shaft bearing forward to give clearance to the 1st/2nd gear set assembly.
14. Pull the main shaft out of the gearbox to the rear.
15. Lift out the 1st gear and the measured thrust washer, then 2nd gear and the synchromesh hub.
16. Lift out the rear 3rd/4th gear set assembly and thrust washers.
17. Remove the front roller bearing from the gearbox case.
18. Press the rear ball bearing off the front of the shaft.

Layshaft

19. Remove the PTO drive shaft front bearing cover.
20. Remove the the PTO shaft circlip and thrust washer.
21. Screw a 7/16 inch UNF bolt approximately 3-4 inch long into the end of the PTO shaft. Drive the shaft out of the bearing.
22. Remove the PTO drive shaft front bearing, see operation 9B.9 .
23. Lift out the PTO constant mesh gear.
24. Remove the snap ring from the rear of the layshaft.
25. Carefully drive the layshaft forward to ease removal of the snap ring in front of the 2nd gear, move it to the un-splined portion of the shaft.
26. Remove the snap ring and thrust washer from the front of the layshaft and then drive the layshaft fully rearwards.
27. Slide the reverse constant mesh gear fully forward. Remove the circlip with a pair of right angled circlip pliers from the front of the synchromesh hub. Slide the circlip as far forward along the layshaft as possible.
28. Drive the layshaft rearwards so that roller bearing is in the rear section of the gearbox.Lift the reverse ratio gear out through the top of the gearbox.
29. Remove the circlip and the synchromesh hub assembly.
30. Remove the forward ratio gear and thrust washer.
31. Relocate the bearing in the centre web and drive the layshaft forward, remove it through the front of the gearbox.
32. Lift out the 2nd, 3rd and 4th gears.
33. Remove the snap ring.
34. Press the front layshaft bearing off the shaft.
35. Remove the rear bearing from the casing.
36. Remove the PTO rear support bearing.

Synchromesh hub assemblies:

37. Remove the two baulk rings.
38. Remove the drive hub complete with the coupler.
39. Wrap the hub and coupler in a cloth.
40. Remove the coupler, taking care not to lose springs, ball pins and pressure blocks.
41. Remove the three pressure blocks.
42. Remove the three ball pins.
43. Remove the three springs.
44. Thoroughly clean all the components and check their condition.
45. Using a feeler gauge, measure the clearance between the ring and the synchromesh cone on the gear at several points. The baulk ring must be correctly positioned on the synchromesh cone. If the clearance is less than 0.020 inch (0.5 mm), replace the baulk ring. If the clearance is checked with the gearbox assembled replace the baulk ring if the clearance is found to be less than 0.031 inch (0.8mm).

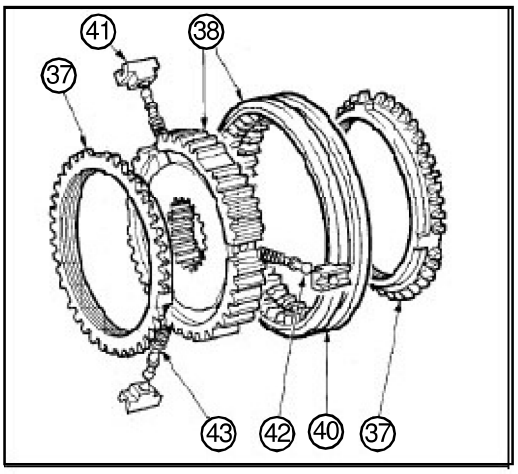


Fig 29

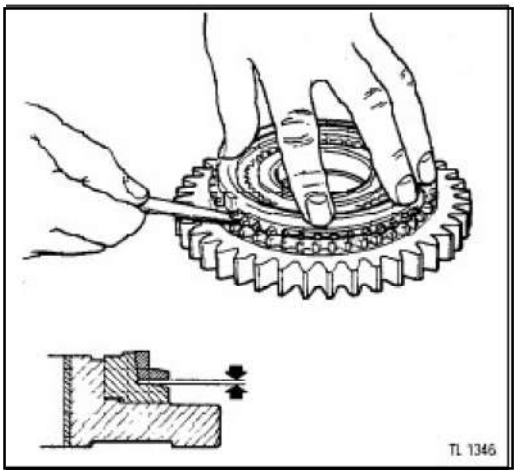


Fig 30

Examination

46. Clean and thoroughly inspect all parts for signs of wear or damage and renew if necessary. Renew all snap rings, when refitting ensure that they are correctly located in their grooves.

Re-assembly

Synchromesh hub assemblies

47. Reverse procedures 37 to 43.

48. On replacing the springs, ball pins and blocks into the coupler, special service tool MF. 415 and handle MS.550 must be used to locate the hub back in the coupler.

49. Place the hub on the work bench and insert the three springs, ball pins and pressure blocks.

50. Carefully place the hub assembly into the ring of MF.415 ensuring that hole 'A' in the hub is in line with the hole 'A' in the side of MF.415. Press the hub down into the tool compressing the pressure blocks, ball pins and springs.

51. Place the hub and tool over the coupler checking that the hole in the tool and hub aligns with the hole in coupler, also check that it is concentric.

    NOTE: *Ensure that the hole 'A' in the coupler is fitted in line with the hole in the hub, it is used to align the selector fork to the rail.*

52. Fit handle MS.550 to the round plate of MF.415 and use it to tap the hub into the coupler. Layshaft

53. Press the front roller bearing onto the shaft.

54. Fit the roller bearing circlip.

55. Fit the rear PTO shaft support bearing.

56. Place the circlip on the un-splined portion of the shaft.

57. Refit the thrust washer at the front of the shaft.

58. Place the 2nd (20T), 4th (29T) and 3rd (28T) gears in the bottom of the gearbox.

59. Pass the layshaft through the front of the gearbox so that the roller bearing is in the first section.

60. Fit the layshaft gears in the above order.

61. Drive the layshaft rearwards so that the roller bearing is in the rear section.

62. Refit the forward gear and synchromesh hub assembly.

63. Place the circlip on the un-splined portion of the shaft close up to the synchromesh hub.

64. Refit the reverse gear assembly.

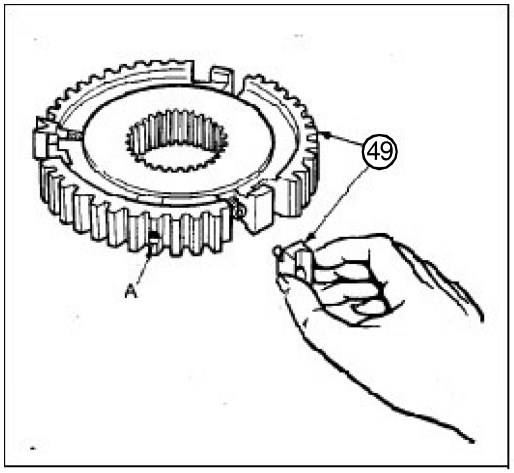


Fig 31

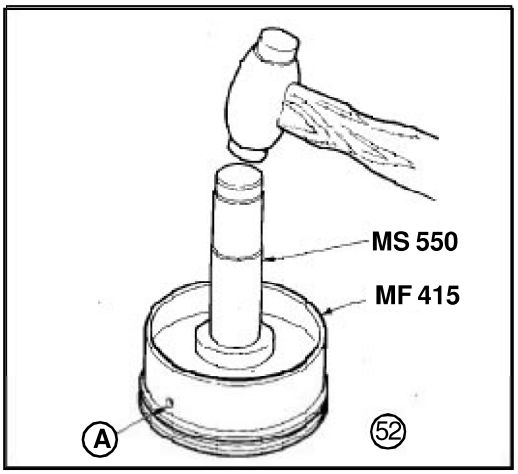


Fig 32

65. Enter the roller bearing into the centre web. Drive the layshaft forward holding the reverse gear set so that it pushes the circlip between the reverse gear and hub into its groove.

CAUTION: Check that the circlip between the reverse gear and the synchromesh hub is correctly seated in its groove.

66. Refit the circlip from the un-splined portion of the shaft into its groove in front of 2nd gear.

67. Place a block between the front of the layshaft and the gearbox casing in the front section.

68. Drive the rear roller bearing onto the end of the shaft and into the gearbox casing.

69. Remove the block and replace the rear snap ring.

70. Refit the thrust washer with the flat face towards the reverse gear and replace the snap ring.

71. Ensure that the shaft is fully forward and check that the layshaft turns freely.

72. Place the PTO constant mesh gear in the bottom of the gearbox and refit the PTO shaft from the rear of the gearbox.

73. Refit the PTO drive shaft front bearing, see operation 9B.9 .

Mainshaft

74. Assemble the mainshaft complete with all hubs, gears, bushes, bearing and thrust washers. Refit circlip. Measure the gap 'B' between the front bearing and the circlip. The gap (end float) should be between 0.080 mm and 0.30 mm.If your measurement falls outside the set limits, replace the calibrated thrust washer 'C', which sits between the bearing and first gear, with one of a choice of varying thickness thrust washers to achieve the desired end float. Calibrated shims part numbers and sizes are as follows:

Shim thickness		Part number
mm	inch	
4.14 - 4.19	0.162 - 0.164	1671 888 M2
4.39 - 4.44	0.172 - 0.174	1671 889 M2
4.62 - 4.67	0.181 - 0.183	1671 890 M2
4.85 - 4.90	0.190 - 0.192	1671 891 M2

75. Slide the mainshaft through the rear of the gearbox, progressively fitting in the following order:

76. Steel thrust washer.

77. 3rd gear (35T) with steel bush and synchromesh cone.

78. Synchromesh hub assembly and baulk ring.

79. 4th gear (40T) with steel bush and synchromesh cone.

80. Steel thrust washer.

81. Assemble the 2nd (40T) and 1st (42T helical) gear pack with the synchromesh hub and steel bushes. Lower the assembly down into the box and slide the main shaft through the assembly.

82. Fit the pre-selected calibrated thrust washer with flat side towards first gear.

83. Refit the epicyclic reduction unit, see operation 9B.6.

84. Drive the front roller bearing onto the mainshaft and into the centre web of the gearbox.

85. Replace the circlip.

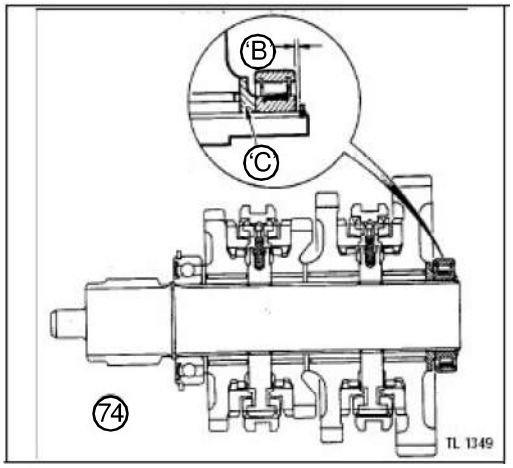


Fig 33

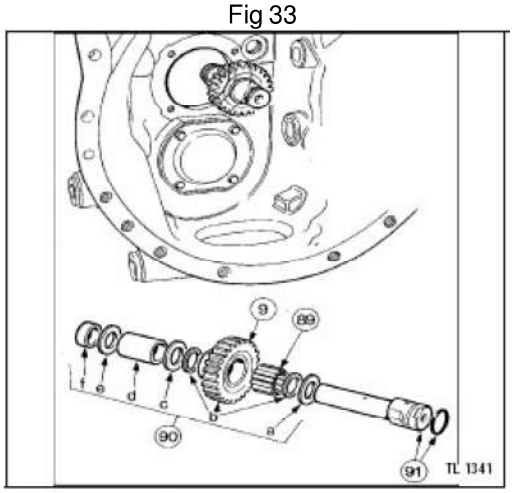


Fig 34

86. Locate the tagged thrust washer in the gearbox centre web with the convex side facing forwards.

87. Refit the needle roller bearing into the front of the mainshaft.

88. Locate the forward/reverse selector fork into the coupler of the layshaft synchromesh assembly.

89. Replace the rollers in the reverse idler pinion, a smear of petroleum jelly, NOT GREASE, will help retain them. There is a single row of 23 rollers with a spacer ring each side.

90. Refit the reverse idler to the gearbox, the order of assembly is as follows:

    a. Thrust washer b. Pinion

    c. Thrust washer d. Long spacer

    e. Thrust washer

91. Renew the 'O' ring on the idler shaft and enter from the bell housing end. Align the cut away portion on the front of the idler shaft to allow fitment of the input housing.

92. Hold the forward and reverse constant mesh gears in the gearbox and refit the transmission input shaft.

93. Refit reversible steel thrust washer to the front of the reverse ratio gear.

94. Refit the input housing assembly, see operation 9B.8 .

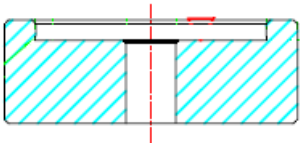
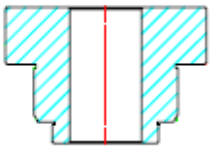
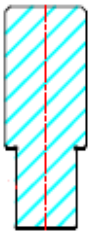
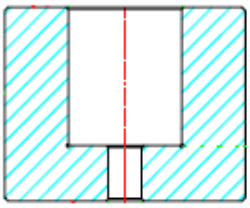
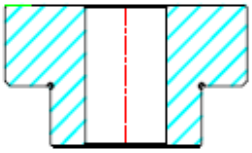
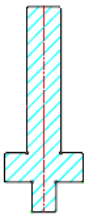
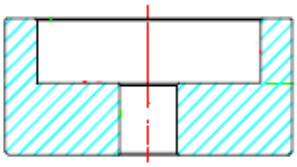
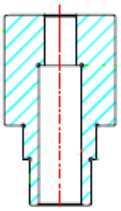
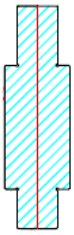
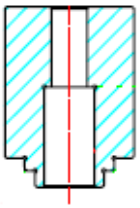
95. Refit the selector rails and forks, see operation 9B.5 .

96. Refit the clutch release mechanism, see operation 9A.6 .

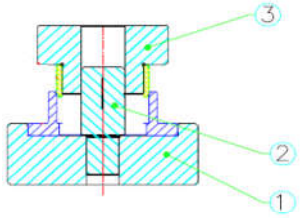
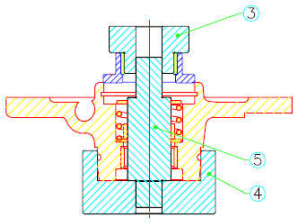
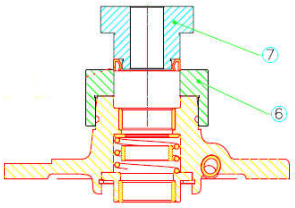
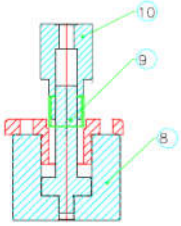
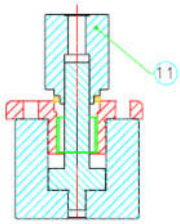
97. Refit the gearbox to the tractor.

98. Renew the 'O' ring on the idler shaft and enter from the bell housing end. Align the cut away portion on the front of the idler shaft to allow fitment of the input housing.

9B.15 - SIDE SHIFT - SERVICE TOOL DETAILS

SL NO	IMAGE	DESCRIPTION	SL NO	IMAGE	DESCRIPTION
1		Locator	7		Pusher
2		Guide	8		Locator
3		Pusher	9		Guide
4		Locator	10		Pusher
5		Guide	11		Pusher
6		Locator			

9B.15 - SIDE SHIFT - SERVICE TOOL DETAILS

SERVICE TOOL NUMBER	DESCRIPTION	IMAGE	REMARKS
SER3000007	Pressing tool (Bush to collar)		1- Locator 2- Guide 3- Pusher
	Guiding tool (SS housing)		4- Guide 5- Locator
	Pressing tool (Seal into SS housing)		6- Locator 7- Pusher
	Pressing tool (Bush into Planetary hsg.)		8- Locator 9- Guide 10- Pusher
	Pusher		11- Pusher

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